PATENT SPECIFICATION 1,066,442

DRAWINGS ATTACHED.

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COMPLETE SPECIFICATION.

Improvements in Disc Brakes.

We, DUNLOP RUBBER COMPANY LIMITED, a British Company of 1, Albany Street, London, N.W.1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to disc brakes and more particularly relates to self-energising or servo disc brakes of the kind comprising a rotatable disc and at least one non-rotatable friction element which is constrained to move in a path inclined to the braking surface of the disc in such a manner that a servo effect is obtained when the brake is applied and the disc is rotating in a direction corresponding to forward movement of the vehicle.

It has been proposed that the inclined friction element should be attached to a brake support by a link which pivotally engages the friction element at one end and the support at its other end to constrain the friction element to move in an inclined direction towards the disc.

With an arrangement of this type the degree of self-servo action obtained is dependent upon the angle between the braking surface of the disc and a line passing through the pivot points of the link. Consequently the self-servo action varies throughout the wear life of the friction element because the angle of the link varies proportionally to the thickness of the friction material.

One object of the present invention is to provide a servo disc brake wherein the foregoing disadvantage is largely overcome.

According to the present invention a disc brake comprises a rotatable disc, a non-rotatable support straddling a minor portion of a periphery of the disc, a thrust device attached to the support, a friction element associated with the thrust device and adapted to be moved towards the disc along an axis inclined relative to the plane of the disc, an abutment surface on said support, said surface being parallel to the axis of movement of the friction element to guide said element towards the disc, and a rigid link having one end pivotally connected to the friction element and the other end engageable with the inclined abutment surface in such a manner that it is progressively movable towards the disc along said abutment surface as wear of the friction element occurs.

Three embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:—

Figure 1 shows a disc brake assembly suitable for use as a rear brake, viewed in an axial direction of the disc, and shown partly in cross-section;

Figure 2 is a radial view of the brake assembly shown in Figure 1 partly in cross-section;

Figure 3 shows an alternative rear brake assembly, viewed in a radial direction of the disc, and

Figure 4 shows an alternative disc brake assembly suitable for use on a front wheel brake.

The self-servo disc brake shown in Figures 1 and 2 comprises a non-rotatable support in the form of a caliper-type housing 10 straddling a minor portion of a periphery of a rotatable brake disc 11. The housing is provided on one side of the brake disc with a cylinder 12 the axis of which is inclined to the plane of the disc at an angle of

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approximately 45°. The housing 10 is arranged so that the normal direction of rotation of the brake disc, as indicated by the arrow, corresponding to forward movement of the vehicle is into the angle formed between the axis of the cylinder 12 and the plane of the disc 11. The cylinder 12 is provided with a piston 13 which is fluid-tightly slidable therein under the pressure of hydraulic fluid supplied to the closed outer end of the cylinder 12 by a conduit 14 connected to a brake master cylinder (not illustrated). The piston 13 and cylinder 12 form a thrust device which is adapted to apply pressure to an associated friction element 15, the line of action of the thrust device being along the axis of its cylinder.

The piston 13 is provided with a connecting rod 16 extending from the face thereof near the brake disc 11. The connecting rod 16 is formed integral with a thrust plate 17 which is adapted to engage the friction element 15. The friction element can comprise a block of friction material 18 *per se* or a block of friction material attached to a backing plate 19 as illustrated in Figure 2.

A second friction element 20 on the opposite side of the brake disc 11 is rigidly secured to the housing 10 which is capable of sufficient axial movement to enable the fixed friction element 20 to engage the brake disc 11 due to the reaction forces produced when the brake is applied.

Adjacent the trailing edge 21 of the movable friction element 15 a rigid link 22 is pivotally secured to the thrust plate 17 by means of a pivot pin 23 passing through the inner end of the link 22 and the thrust plate 17 in a direction parallel to the adjacent radial direction of the disc. The link 22 is inclined to the plane of the brake disc 11 and is disposed at an angle of approximately 90° to the axis of the cylinder 12.

The outer end 24 of the link 22 is adapted to pass through a slot 25 machined in a trailing abutment flange 26 formed on the housing 10. Said abutment flange 26 is preferably arranged at an angle which is aligned with the axis of the cylinder 12.

The link 22 is provided adjacent its outer end 24 with a pair of reaction pins 27 and 28 extending in a direction parallel to the pivot pin 23 and positioned one adjacent each of the inner and outer surfaces of the abutment flange 26. The arrangement of these reaction pins 27 and 28 is such that when the brake is applied with the brake disc 11 rotating in a direction corresponding to forward movement of the vehicle the pin 27 abuts the inner surface of the flange 26 to take the reaction forces whilst when the brake is applied with the brake disc 11 rotating in a direction corresponding to reverse movement of the vehicle the pin 28 abuts the outer surface of the flange 26 to take the reaction forces.

A coil spring 29 encircling the pivot pin 23 is fastened to the link 22 in such a manner as to tend to maintain the link 22 at the desired angle to the axis of the cylinder 12 when the brake is in the released position.

A substantially bell-crank-shaped lever 30, having arms 31 and 32 of unequal length is pivoted at its fulcrum 33 between a pair of supporting webs 34 extending axially outward from the outer surface of the abutment flange 26. The longer arm 31 of the bell-crank lever 30 extends substantially axially away from the brake disc 11 to terminate at the remote end thereof in a bifurcated portion 35 adapted to receive a trunnion block 36. The outer cover 37 of an actuating cable 41 is fitted to the trunnion block 36 whilst the inner wire cable 38 extends beyond the lever arm 31 to engage a lug 39 formed on the outer end of the cylinder 12. The shorter arm 32 of the bell-crank lever 30 forms the pivot point for one end of a thrust rod 40 which extends towards the disc to pivotally engage at its other end the thrust plate 17 intermediate the leading and trailing edges thereof.

The brake is operated by the introduction of fluid pressure into the cylinder 12 to force the piston 13 together with the associated thrust plate 17 towards the disc or by tensioning the actuating cable 41 to pivot the bell-crank lever 30 and through the medium of the thrust rod 40 to force the thrust plate 17 towards the disc 11. In both cases movement of the thrust plate 17 brings the friction element 15 into engagement with the adjacent braking surface of the disc 11. As the friction element 15 is pressed against the disc 11 the reaction set up on the housing 10 causes it to move axially to bring the friction element 20 attached thereto into engagement with the opposite braking surface of the disc 11. When the brake is applied with the brake disc rotating in a direction corresponding to the forward movement of the vehicle the circumferential drag exerted on the friction element 15 causes the reaction pin 27 to be forced into engagement with the inner surface of the abutment flange 26 and thereby set up reaction forces which serve to press the friction elements against the disc with increased force.

If wear of the friction elements occurs during the braking operation, on release of the brake the outer end 24 of the rigid link 22 is advanced along the abutment flange 26 towards the disc 11 by the spring 29 through the same distance as that through which the friction elements have moved to compensate for wear.

With self-servo type disc brakes the difference in the braking force between forward and reverse movement of the vehicle can be in the order of 2:1 which is acceptable with fluid pressure operated brakes but when applied to a mechanically-operated emergency or parking brake this difference can be a great disadvantage.

This disadvantage is largely overcome in the embodiment illustrated in Figure 3 which is basically the same as the embodiment described with reference to Figures 1 and 2 and consequently like reference numerals have been used for like parts.

In this embodiment the inner end of the rigid link 22 is positioned in a groove machined in the thrust plate 17. The pivot pin 23 is rigidly secured to the link 22 and extends in a direction parallel to the adjacent radial direction of the disc 11 to be located in a cam slot 42 formed in the thrust plate 17. The longitudinal axis of the aperture 42 preferably extends at right angles to the axis along which the friction element 15 is constrained to move.

When the brake is actuated by the fluid pressure operated thrust device or the mechanically operated lever mechanism to move the friction element 15 into engagement with the brake disc the reaction on the housing causes the fixed friction element to be pressed against the opposite face of the brake disc. When the disc is rotating in a direction corresponding to forward movement of the vehicle the circumferential drag exerted by the brake disc on the friction elements causes reactions to be set up in the rigid link in the same way as described with reference to the previous embodiment, causing the pressure on the friction elements to be increased.

When the brakes are applied with the disc rotating in a direction corresponding to the reverse movement of the vehicle the drag exerted by the disc on the inclined friction element causes the reaction pin 28 to be forced against the outer surface of the abutment flange 26 and the pivot pin 23 to slide along the cam slot 42 to set up a wedging action between the cam slot and the pivot pin which tends to urge the friction elements against the brake disc with an increased force.

With this arrangement it is possible to obtain a servo force in the reverse direction of travel which is substantially equal to the servo force obtained in the forward direction of travel.

The embodiment illustrated in Figure 4 is more suited for use on the front wheels of motor vehicles since it does not include the mechanically operated emergency or parking brake that has been described with reference to the previous embodiments.

In this embodiment the support is again in the form of a caliper-type housing 10 straddling the brake disc 11 having a fluid pressure operated piston and cylinder mechanism forming a thrust device 43 located on one side of the disc with the axis inclined to the plane thereof. The friction element 20 on the other side of the disc is secured to the housing as previously described.

The inclined friction element 15 together with thrust plate 17 is similar to that described in the previous embodiments but in this case the rigid link 44, which is again pivoted to the thrust plate 17, is provided at the end thereof remote from the brake disc 11 with a cam surface 45 which is adapted to engage the abutment flange 26 formed on the housing 10.

Spring means 46 is again provided between the thrust plate 16 and the rigid link 44 to ensure that the link is maintained at the desired angle to the axis of the thrust device 43 when the brake is in the released position.

In operation the thrust device 43 is pressurised to move the inclined friction element 15 into engagement with the brake disc 11. As the friction element 15 is pressed against the disc the reaction on the housing causes the fixed friction element 20 to be pressed against the opposite side of the disc. The circumferential drag exerted by the disc 11 on the friction elements is sufficient to force the cam surface 45 of the link 44 into engagement with the abutment flange and cause a reaction to be set up therein which will act to press the friction elements against the disc with increased force.

The constructions described herein for attaching the rigid link to the thrust plate and the abutment flange are given by way of example only and are not intended to form a limitation of the present invention, for example in the embodiments shown in Figures 1 to 3 the link could be of cylindrical form and adapted to be slidably engaged in a bore of complementary diameter in the thrust plate.

WHAT WE CLAIM IS:—

1. A disc brake comprising a rotatable disc, a non-rotatable support straddling a minor portion of a periphery of the disc, a thrust device attached to the support, a friction element associated with the thrust device and adapted to be moved towards the disc along an axis inclined relative to the plane of the disc, an abutment surface on said support, said surface being parallel to the axis of movement of the friction element to guide said element towards the disc, and a rigid link having one end pivotally connected to the friction element and the other end engageable with the inclined abutment surface in such a manner that it is

progressively movable towards the disc along said abutment surface as wear of the friction element occurs.

2. A disc brake according to claim 1 wherein the thrust device comprises a piston and cylinder mechanism arranged with its line of action inclined relative to the plane of the disc.

3. A disc brake according to claim 2 wherein the piston is rigidly secured to or integral with a thrust plate to which the friction element is detachably secured said piston being constructed so as to be able to tilt in its cylinder to permit movement of the friction element transverse to the line of action of the thrust device.

4. A disc brake according to any of claims 1—3 wherein the rigid link is pivotally connected to the thrust plate by means of a pivot pin passing through the thrust plate and the rigid link in a direction parallel to the adjacent radial direction of the disc.

5. A disc brake according to claim 4 wherein the end of the rigid link remote from the pivot pin extends through a slot machined in a flange having inner and outer abutment surfaces and is provided with a pair of reaction pins extending parallel to the pivot pin, one adjacent the inner abutment surface of the flange and one adjacent the outer abutment surface of the flange.

6. A disc brake according to claim 5 wherein the pivot pin is located in a cam slot having its longitudinal axis at right angles to the axis along which the friction element is movable by the thrust device.

7. A disc brake according to claim 5 wherein the pivot pin is rigidly secured to or integral with the rigid link and is positioned in a cam slot formed in the thrust plate, said cam slot having its longitudinal axis at right angles to the axis along which the friction element is movable by the thrust device.

8. A disc brake according to claim 4 wherein the end of the rigid link remote from the pivot pin is formed with a cam surface adapted to engage the abutment surface.

9. A disc brake according to any of claims 4 to 8 wherein spring means is provided between the thrust plate and the rigid link to ensure that the link is maintained at the desired angle to the axis of the thrust device when the brake is in the released position.

10. A disc brake according to any preceding claim wherein only one friction element movable relative to the housing and thrust device is provided, on one side of the disc, a second friction element being fixed to the support on the other side of the disc and the support being axially movable relative to the disc.

11. A disc brake according to claim 9 wherein a mechanically operated hand brake mechanism is provided to force the inclined friction element into engagement with the disc.

12. A disc brake constructed and arranged substantially as described herein and illustrated in Figures 1 and 2 of the accompanying drawings.

13. A disc brake constructed and arranged substantially as described herein and illustrated in Figure 3 of the accompanying drawings.

14. A disc brake constructed and arranged substantially as described herein and illustrated in Figure 4 of the accompanying drawings.

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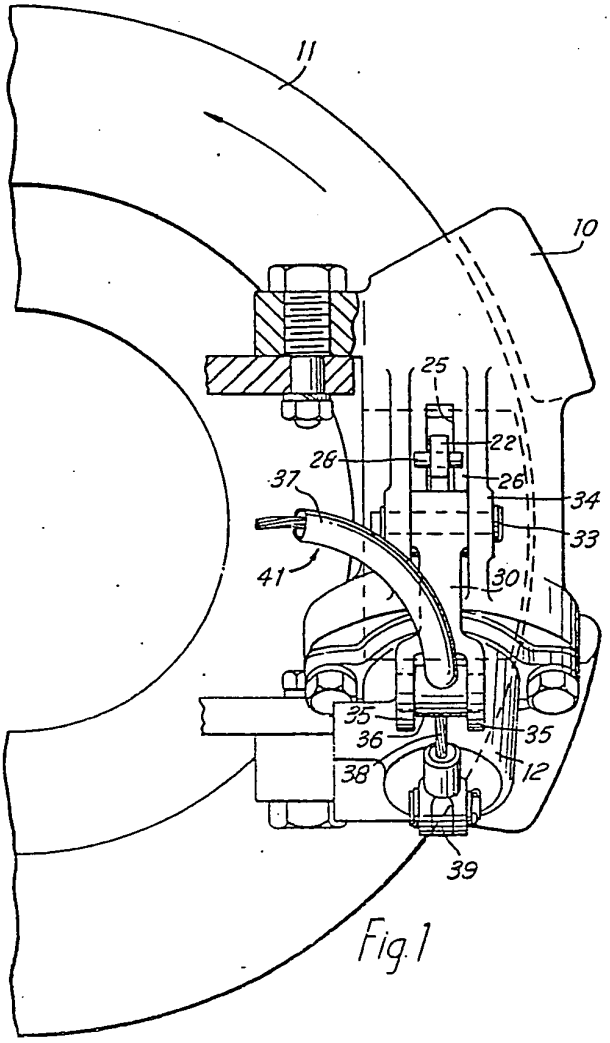

Fig. 1

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Sheets 1 & 2

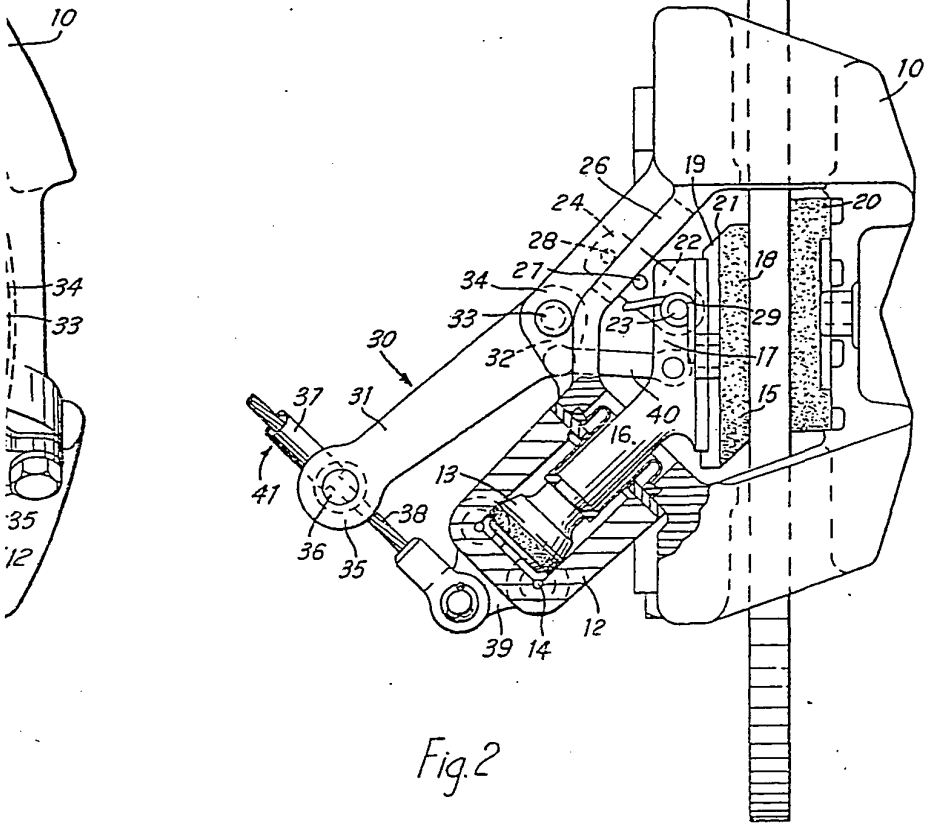

Fig. 2

1066442 COMPLETE SPECIFICATION
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Sheets 1 & 2

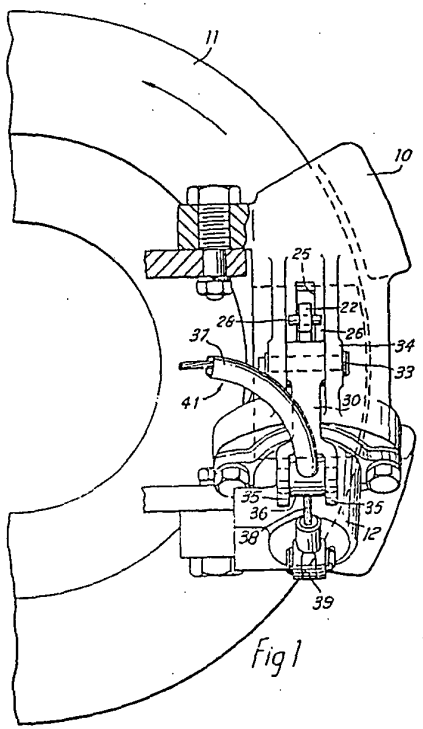

Fig 1

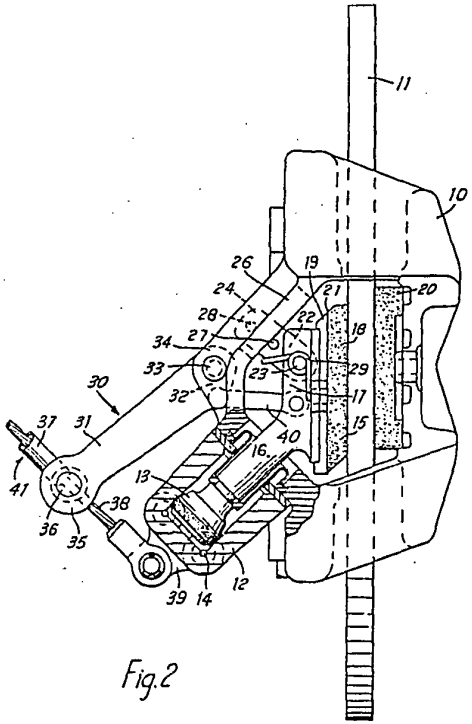

Fig.2

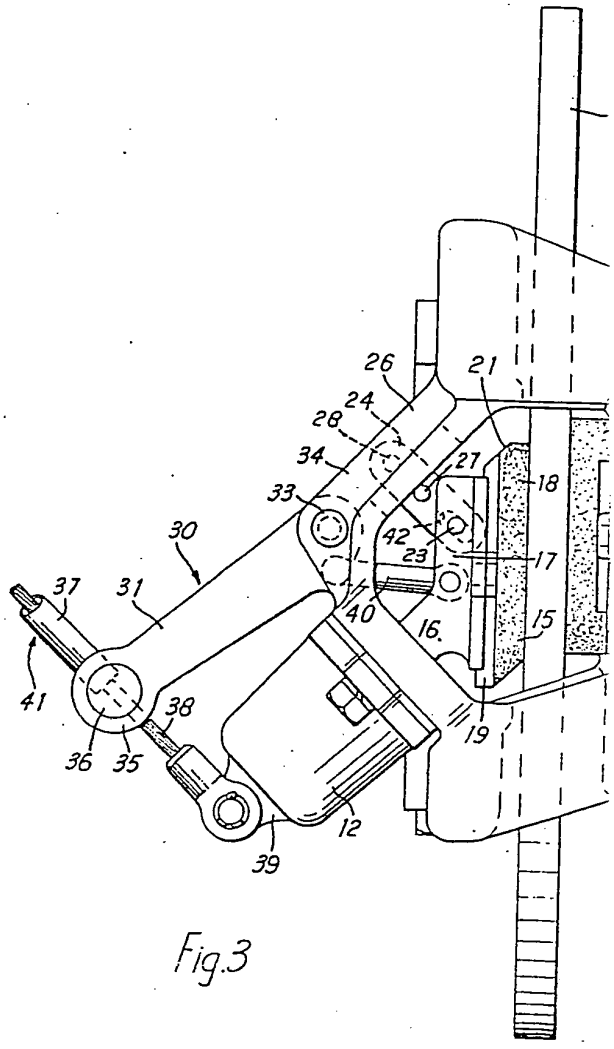

Fig.3

1066442 COMPLETE SPECIFICATION
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Sheets 3 & 4

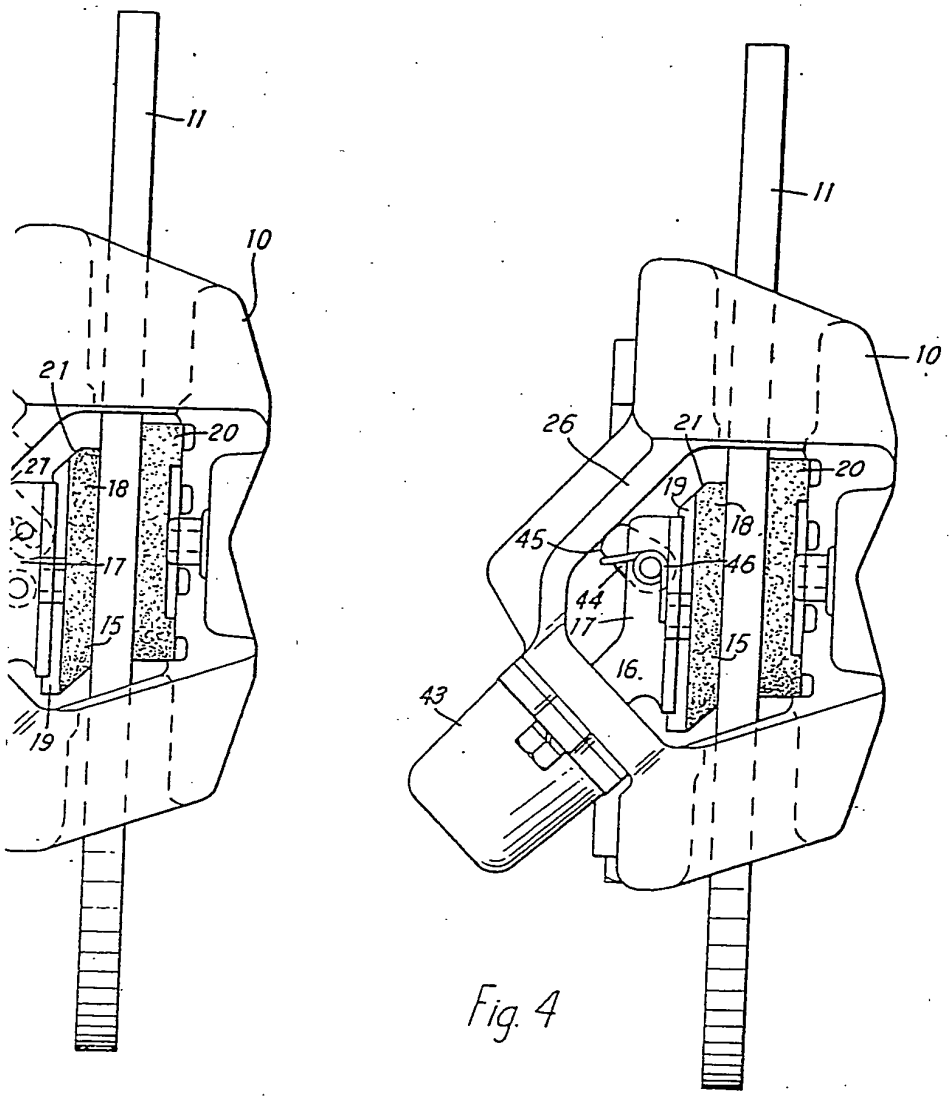

Fig. 4

1066442 COMPLETE SPECIFICATION
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Sheets 3 & 4

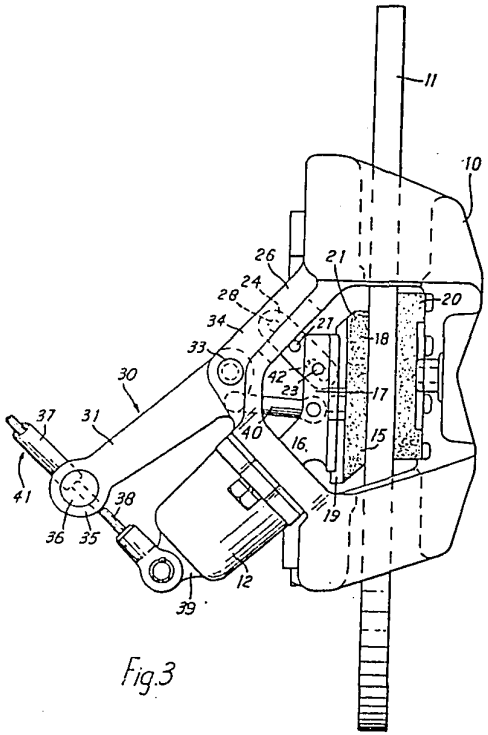

Fig.3

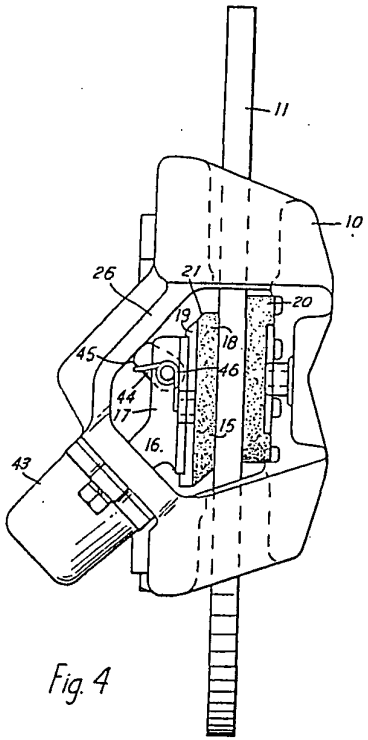

Fig. 4